An Inquiry into the Etiology of Rötheln.

Donald W. C. Hood.

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With the Authors Compliments

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INQUIRY INTO THE ETIOLOGY OF RÖTHELN

(GERMAN MEASLES)

BY

DONALD W. C. HOOD, M.D.Cantab., F.R.C.P.Lond.

Senior Physician to the West London Hospital

" I am a firm believer that without speculation there is no good and original observation."—Darwin

London
JOHN BALE & SONS
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PREFACE.

THIS paper, a short abstract of which was read before the Royal Medical and Chirurgical Society on the evening of March 14, 1893, was not considered by the Council as "suitable for publication" in the *Transactions* of that Society.

The subject doubtless has been treated in a speculative manner, and thus far lies beyond the confines of clinical medicine, but it is none the less instructive and interesting to attempt to unravel some of the mysteries connected with our common infectious diseases. It appears to the author that even "German measles" may prove worthy of investigation when its possibilities of evolutional changes are considered by the light of modern knowledge. And he believes that the main principles underlying evolution may be made use of as an hypothesis towards explaining the differences—variations of type—which are so constantly met with in diseases which are now considered as owing their cause to micro-organisms. It cannot be disputed that clinically we are daily meeting with marked instances of variation in the expression of the phenomena which accompany the manifestations of all such diseases. We see every variety in the effect of the virus of diphtheria, malaria, scarlet fever, variola, &c., &c., when influencing its human "host." Upon what does such variation depend?

With but few exceptions all students of medicine are in accord in looking upon the essential factor of such diseases as being of an organic nature. The seed which in due course produces its baneful harvest is continually falling upon a variety of "soils." As the intercourse between people becomes more and more easy, locality no longer impedes distribution, seed is carried from one quarter of the globe to another, and so immunity will tend to become general.

Further, as the world grows older, the potential receptivity with regard to any specific infecting organism, will, under the ordinary condition of life, become less and less.

The writer doubts whether with the exception of influenza there is any other infectious disease assuming such a variety of phases as "German measles."

Practically the affection comes before us with a measle-like rash, or with an eruption not to be distinguished from that of scarlet fever.

These two main groups are more or less connected together by a host of intermediate forms which differ one from another as much in constitutional disturbance as they do in their dermatological characters.

These dermatological characters are not invariably transmitted from patient to patient without change. In other words, as regards rash the specific organism does not "breed true."

A patient with scarlatinaform rash may infect another individual in whom the rash may be that of measles. A patient with the rash of measles may infect another in whom the eruption is that of scarlet fever.

Frequently we may have the opportunity of observing the two rashes combined in the same patient.

With the milder forms of the disease with scarlet rash the problem of diagnosis may become a very difficult one, and without knowledge of the duration of the incubation stage, it is in some cases impossible to say whether the disease be German measles or scarlet fever.

AN INQUIRY INTO THE ETIOLOGY OF RÖTHELN.

(GERMAN MEASLES.)

THE group of clinical symptoms known to us under the name "Rötheln" has been frequently referred to and described. But among the more common diseases it would be difficult to name one which has given rise to such diverse expressions of opinion, with regard, not only to its essential nature, but, curiously also, as to what may be considered its fundamental or specific symptoms. Writers on this affection may be grouped in three classes, namely, those who maintain the specific nature of the disease; those who regard it as being of a hybrid origin, *i.e.*, as being related to both measles and scarlet fever; and those who consider it as being but a form of measles.

I presume that most, if not all, practical physicians have been puzzled from time to time by those anomalous exanthematous rashes which appear in many ways to resemble measles, and yet depart so widely from the type of that well-known disease. These anomalous eruptive fevers, apart from the importance attached to them from a clinical and diagnostic standpoint, open out questions of great biological interest.

With one of such problems it is my intention to deal, and I shall endeavour to show on clinical as well as theoretical grounds, that an hypothesis is not untenable which assumes that the specific contagium of measles, being a living organism, as such will be liable to undergo variation, and will be subject to evolutional changes in adapting itself to varying conditions of "soil"; and that some such hypothesis will afford a clue towards explaining the many affections of exanthematous character which depart more or less from the true measles type.

The writer feels bound to add that he does not approach the subject from a mere theoretical and speculative standpoint; the possible variation in the specific contagium of measles has, undoubtedly, for many years, actuated him in making inquiry into the true etiology of rötheln. But he believes that a careful examination into the *clinical* phenomena attending these anomalous eruptive fevers, will tend to support his argument, an argument which will certainly also gain support from the behaviour of many, if not all, infectious diseases, from the laws underlying vaccination, and from laboratory experiments on the natural history of micro-organisms.

What are the specific characteristics of the disease known to us under so many names, but, perhaps, most commonly designated rötheln or rubeola? What are those peculiar, specific symptoms which entitle the disease to rank as an entity?

I have attempted to answer these questions by examining our best text-books of practical medicine, and the numerous papers and illustrative cases which are to be found scattered through our journals and reports. Having done so I was surprised to find that scarcely any two writers agree as to what constitutes the specific symptom or group of symptoms, marking the disease as being distinct.

? Dr. Eustace Smith's Remarks –

In the course of a discussion on Rubella at the Med. Off. Schools Assⁿ, on [illegible] May 14/90 Dr Eustace Smith said he was surprised to hear the different speakers talking of the disease as if it were common, he in his own experience it was rare. E.S. – I

With regard to the description of other eruptive fevers, there is no such want of agreement. The descriptions of scarlet fever, measles, variola and varicella, are, within very narrow limits, much the same, whatever may be the source from which the clinical portrait comes. This marked want of agreement among those who write on rötheln is certainly exceptional, when we consider that they describe only the ordinary uncomplicated symptoms of a supposed specific disease; moreover, a disease which is far from uncommon. This strange discrepancy of opinion must be referred to at much greater length. For the moment I only allude to the matter as a reason for not giving a detailed clinical picture of rötheln. In place of such description I will briefly allude to those cases, or groups of cases, which have been under my own personal observation, and which, in the aggregate, will be found to include all the symptoms looked upon as being pathognomonic of the disease.

The first group consists of a family of five individuals—mother and four children. The attack was characterised by a scarlatinaform rash without prodromal stage, affecting three children who had previously suffered from ordinary measles, and the mother and infant, who had not had measles. E.K.

On March 5, 1887, I was asked to see a child aged 3. I was told that the previous evening the patient had been covered from head to foot with a brilliant red rash. I saw the child late in the day: pulse and temperature were both normal. No rash was present, but the skin appeared suffused and mottled. There was no catarrh. Previous to the appearance of the rash there had been twenty-four hours of slight malaise, and the child had sneezed several times as if suffering from an ordinary cold in the head.

On March 17, twelve days later, the mother was seized with sudden illness. She had gone to bed feeling perfectly well, but passed a restless, disturbed night, and in the morning found she was covered with a red rash.

I saw the patient the same day: she was suffering from severe constitutional symptoms, a rapid bounding pulse, high temperature, and much headache and sore throat. She had the most intense coryza and lachrymation, the whole face being swollen. From head to foot she was completely covered with a brilliant scarlet rash, a rash not to be distinguished from that of scarlet fever. At this period of illness no outlying papules on feet or hands could be seen. There was no glandular enlargement. On the second day of the illness she complained of feeling more ill, though the pulse and temperature were both little above normal. The catarrhal symptoms were now more marked, the face being distorted and much swollen, the eyes injected and streaming with tears. The rash was of the same character on face and body, but on the hands and feet it was now distinctly papular. On the third day the patient expressed herself as feeling quite well; she had slept through the night. The catarrhal symptoms had gone and the rash was much faded, and by the following day had all but disappeared. During the attack there was no albumen present in the urine.

On March 19, two days after the commencement of the mother's illness, an infant in arms had a very slight, but well-marked, papular rash, which extended over the whole body. The papules were in no place confluent, being small and sparsely scattered from head to foot. The child sneezed occasionally, but beyond this there were no constitutional symptoms. Forty-eight hours later, the two remaining children were found to have a slight papular eruption unaccompanied by any symptoms of catarrh or constitutional disturbance. There had been absolutely no prodromal stage. The attack was followed by whooping-cough. Six months previous to this exanthem, the three elder children had suffered from measles with the ordinary prodromal stage of four days of catarrh.

I will now refer to a case in which the exanthem commenced as a very slight papular rash without prodromal stage, with catarrhal symptoms concurrent and increasing with the eruptive period, occurring in a child who had not suffered from any form of measles.

The child was first seen by me on May 27, 1887. The nurse had noticed in the morning a few red spots on the face and chest: when I saw the case a few hours later, beyond a very few small papules scattered over the upper part of the body, there was no symptom denoting illness. The child was full of spirits and apparently perfectly well; temperature and pulse both being normal. The following day the general condition was much the same, but the rash had spread over the entire body. Although the distribution was general, the papules were still small and few in number.

? S.M.
? heat.

On the third day the rash covered the face, where it had lost its papular character and now formed irregular raised blotches. On the trunk and extremities the rash was still papular, but the individual papules were of larger area and far more numerous. There was no lachrymation, but the eyes were intensely suffused, the caruncles reddened and swollen, giving a very strange appearance to the face; the throat red with papular rash but not painful; a constant, dry, hacking cough; pulse 100; temperature 101°. The child did not appear ill, complained of being kept in bed, and played with toys.

On the fourth day, the eruption was much more pronounced, standing out in irregular-shaped blotches, the skin between the blotches suffused and covered with small papules of varying size. Constitutional symptoms very severe; rapid bounding pulse; temperature in morning 104°; an almost constant cough, but no bronchial complications. The patient remained throughout the day in an anxious, alarming state, but at five p.m. the attack ended by "crisis," and at nine p.m., pulse and temperature were practically normal. A good night was passed, and the following day the child appeared well; there was some slight enlargement of the glands of neck and at angle of jaw; the urine did not contain albumen, and the attack was not followed by desquamation.

In endeavouring to trace the infection of this case, I found that twelve days before the initial symptoms, the child had been to a party. One of the children present had sickened the following day, with what was considered to be scarlet fever. I saw the medical man in charge of the case, and from his description of the patient, I considered the affection had been rötheln and not scarlet fever.

The next case is one of a scarlatinaform exanthem, with a prodromal stage of indefinite malaise and slight sore throat, occurring in an adult who had not suffered previously from either measles or scarlet fever.

On July 15, 1877, I saw a lady, aged 35, who told me that she had been feeling poorly for three or four days, having headache and sore throat. On the morning of the day of my visit she found her face and chest covered with a red rash. I saw the patient at 9.30 a.m.; her face, chest, abdomen and sides were covered with a bright scarlet rash, a rash not to be distinguished from that of scarlet fever. The throat was reddened and injected, the discoloration being regular and without any papular arrangement; the redness extended over both tonsils, which were not swollen, the entire soft palate and a portion of the hard. The tongue was thickly coated with a yellow fur. With the brilliant rash and reddened fauces, beyond very slight discomfort on swallowing, there were absolutely no constitutional disturbances. Pulse and temperature were both normal, and the patient expressed herself as feeling perfectly well.

The conditions being so anomalous, I asked Dr. Broadbent to see the case with me. He did so later in the day, and at the time of his visit pulse and temperature were normal. The rash at its spreading margins was now distinctly papular; this had not been so earlier in the day. Dr. Broadbent agreed with me that the illness was rötheln.

The following morning, the rash had faded from the face and upper part of chest. It had extended down the thighs and arms, and in advance of the rash were numerous isolated papules. There was slight cough but no injection of eyes or other form of coryza. The throat was no longer sore, though the rash was here more brilliant than on the previous day. There was slight constitutional disturbance, temperature being 100°; pulse 96. On the third day, the rash had entirely faded from face and chest; on the thighs, legs, arms and forearms it was confluent and vivid. On the backs of both hands and on the dorsum of feet it was papular. A good night had been passed and all constitutional disturbance had passed away.

On the fourth day, the rash had entirely faded, with the exception of that on the hands and feet, where it was now bright and confluent. On the anterior surface of the middle third of the right thigh the skin was red, swollen, tender and hot, and here, apparently, the intense rash had caused a local dermatitis. This inflammatory condition lasted four days, the part freely desquamating. On July 28, being the fourteenth day of illness, there was general desquamation, the epithelium coming off hands and feet in broad glove-like flakes. Throughout the attack the urine was normal.

Two months elapsed before I saw the patient again; she told me that during the whole of this time she had been desquamating, and on the day of my visit, the skin was still pealing from hands and feet.

The household consisted of the patient's husband and

? R.W.

? from non-infective erythema.

four young servants, none of whom, to their knowledge, had suffered from scarlet fever. The patient, during the interval of two months, had made numerous visits to country houses, and in no case was infection conveyed to others. This fact, added to the clinical course of the exanthem, seemed to fully establish the accuracy of the diagnosis, though I have no hesitation in saying that had the patient been seen during the stage of desquamation, this diagnosis might well have been called in question.

During December, 1891, a very similar case occurred in my practice at the West London Hospital. A girl, aged 19, who was thought to be the subject of scarlet fever, was under the care of one of my surgical colleagues. The description of the rash given with the last case applied in every particular, and, curiously, this patient, as the last, had a patch of local dermatitis affecting the skin over the left thigh.

The following cases show the disease affecting principally the glands running along the posterior border of the sterno-mastoid and on the mastoid process, this glandular trouble preceding the eruptive period.

In June, 1888, I was asked by a friend—a dental surgeon—to see his daughter, who, he stated in his letter, had been suffering from painful swollen glands of the neck. I found the attack had commenced three days before, and had been preceded by a patchy anomalous rash on face and throat. The eruption was not accompanied by any constitutional disturbance and was considered unimportant. I understood that fourteen days previous to the development of the rash, a sister had been poorly with a mild attack of "German measles," but as the attack had not been preceded, accompanied, or followed by the slightest constitutional disturbance or glandular enlargement, the diagnosis had been doubted, and the possible connection between the two illnesses overlooked, especially as a few months before all the children had suffered from ordinary measles.

R.W.

The patient I was asked to see was found to have the glands swollen and tender, those on the mastoid process being acutely painful. The rash had faded and there was no constitutional disturbance. Sleeping in the same room was another sister, and I found that her glandulæ concatenatæ were also swollen but not painful. Five days later she developed a bright papular rash, but beyond having a tongue thickly coated there was no symptom denoting constitutional trouble.

On June 2, 1892, a lady consulted me for swollen, painful glands on mastoid process. At the time I made a note that I had never seen such glandular swelling excepting in connection with rötheln, but I had not the slightest suspicion that in this case the true cause was rötheln. Seven days later I had a letter from my friend Dr. Schacht, stating that he had been called to see the patient and found her covered with rash. She passed through a very mild attack of rötheln, the catarrhal symptoms being limited to slight coryza, suffused eyes and nasal catarrh.

I will now ask your attention to the case of two children who were exposed to the contagium of measles at the period of decline of a village epidemic, the attack being slight and wanting in character. Some years later, being again exposed to a contagium of extreme intensity, they both passed through measles, typical in every particular.

In the year 1875, I was living in a country village. In the immediate neighbourhood was a very general epidemic of measles. Scarcely a house escaped infection, which was of mild but regular type. Among those who suffered was a lady who had never had the disease. She passed through a sharp attack. Fourteen days later her two children fell ill with coryza, raised temperature, and an ill-defined measly rash, the papules being small, discrete, with no tendency to run together into crescentic blotches. In truth the eruptive period was so indefinite, that had not the specific contagium of measles been present in the house, I should have had some hesitation in making a diagnosis of measles. Most of the children who suffered from measles were subsequently attacked with whooping-cough, and in the case of the two children referred to, their illness was followed by the cough.

In 1879, four years later, the family had left the country and were living in London, and at that time there was a very severe outbreak of measles in the neighbourhood in which they were living. Many pupils at a certain day school were attacked, and among them the two children who had previously been under my care. In their case the illness was of but moderate intensity, but entirely typical of normal measles, with, perhaps, rather more laryngeal irritation than is usually seen. This complication was very general during the epidemic, which was of such unusual severity that it was specially referred to by Dr. Cheadle in a paper read before the International Medical Congress, held in London in 1888. This paper, and the opinion held by Dr. Cheadle, I shall have to discuss at a later period.

M.

In April, 1889, a young lady came under my care suffering from a rash of measly type. On waking on the morning of my visit the patient had noticed that her face and chest were covered with "spots." The rash was papular and like measles. It was not preceded or accompanied by any constitutional disturbance. The evening temperature was 99·5°. The following morning the eruption had extended over the entire body and was, without doubt, the rash of measles; there was now slight cough and coryza, but no rise of temperature. The patient was not isolated from two other children in the same house, neither of whom had suffered from measles, a very interesting fact in the above case being that this patient had been under my care twice previously for measles, on both occasions the attack being typical.

R 'M'

Being much interested in this case I endeavoured to trace the source of infection. I ascertained that the patient was in the habit of attending morning classes, and that at the time of her illness several of her friends and fellow pupils had sickened with an attack much the same as that described. I communicated with the doctors in charge of these cases, and they very kindly supplied me with full information. In each case the attack was much the same as with my own patient; the outbreak apparently was initiated by a young maid-servant who was accustomed to call at the school and attend some of the pupils on their way home. As far as I could learn, it was only those pupils who walked with this maid who were ill. Dr. Argles, of Oxford Terrace, under whose care the servant came, has given me an account of her illness, which was as follows :—

"Miss A. B. (one of the pupils) has just recovered from a slight attack of what I believe to have been rötheln. The invasion stage was very indistinctly marked, merely a slight catarrh. Eruption a typical rash, but it quite disappeared in four days. The first case which appeared in the house was of much more importance and interest ; it was a young country servant in whom an attack of herpes was followed by a most abundant morbilliform rash, first on the face and then over the whole body. It presented altogether so unusual a character, that I asked Dr. Duffin to see her, and she was transferred to King's College Hospital. His opinion was that it was German measles. She had a temperature of 107°, abundant albumen in urine, and was altogether very bad."

It was only those pupils who had been brought directly in contact with the maid, who suffered from this indefinite exanthem ; they all had previously passed through measles, and my own patient, as I have before stated, had had two previous attacks.

We frequently meet with cases which present all the features of measles, but where the prodromal catarrh is much mitigated or entirely suppressed, and I now quote the following cases which are examples of this form.

In May, 1892, I was asked by Mr. Fuller, of Curzon Street, to see with him two patients suffering from a very severe form of exanthem, resembling measles. The illness had commenced with a younger sister, who, twelve days previously, had suffered from a mild attack characterised by a measly rash, which was the one feature of the illness, there being little or no catarrh, fever or constitutional disturbance.

The patients I saw were two young ladies, aged 18 and 19. In each case the illness commenced with pyrexia, in one the temperature being 103°, slight papular rash, very irritating cough, and suffused eyes. For two days the eruption remained discrete and papular, gradually invading the entire surface of the body. On the third day, the rash was noticed as becoming confluent, raised, and brilliant. At this period, the eruptive stage was accompanied with intense pain in the head and eyes; the soft parts of throat were red and injected, the cough being now almost incessant. In the case of one of the sisters, the constitutional symptoms were of alarming severity, and were accompanied with delirium and pneumonia. It is, moreover, a point worthy of note that the sister who suffered by far the least, had had an attack of mild measles six months previously.

I saw several cases of this extreme type of measles without prodromal catarrh, or indeed any marked symptom previous to the eruptive stage, at a school near Newbury, with Dr. Douglas of that town. In these cases, the eruptive period was complicated with various forms of pulmonary mischief which appeared to develop in intensity with the advance of the rash. One pupil had died, and I saw three others most gravely ill. There were a large number of boys attacked, and in all the rash was the initial symptom.

In the *Lancet* for June 25, 1892, there is a paper describing a form of measles for which the writer, Mr. Cantlie, proposes the name "Tropical Measles." I have read this paper with great care, and I can find but little difference between the cases described by Mr. Cantlie and those I have just alluded to. But from my point of view such extreme varieties of the measles type are likely to be more prevalent in one area than another, and will attract the attention of those who are brought in contact with a disease presenting special peculiarities which apparently differentiate them from the normal and specific type.

Occasionally we meet with an epidemic of measles quickly followed by a second, in which the characters are more or less modified, and I now give an account of two separate epidemics of measles type occurring within the same year; the second attack affecting most of those individuals who were sufferers from the first epidemic. For the report of these epidemics, I am indebted to Mr. Leonard Barnes, of Welwyn, Herts.

(*First Epidemic.*)—In August, 1892, an epidemic of morbilli broke out in the village of Whitwell, Herts. The first case was that of a girl aged 21, who had had measles when a child. This case being typical of the epidemic, is described fully.

August 4.—Complained of headache, loss of appetite, sickness. Temperature 102·4°; "cold in head."

August 5.—Well-marked coryza.

August 10.—Rash, which appeared at the roots of the hair, lasted four days, being crescentic, slightly raised blotches, and covered the entire body. The patient made a good recovery.

Within a few days of this initial case, 123 patients were affected, nearly all being children between 1 and 14 years of age; only eight adults were seized. Coryza was present with all, and in some cases there was much lachrymal irritation. In every case there was a prodromal period of from three to four days. The majority of patients passed through a decidedly mild attack, being confined to bed for three or four days only. The infection spread to four neighbouring villages, and in all about 360 cases occurred. In one village the epidemic was specially noted as being extremely mild, and Mr. Barnes saw several children covered with rash "up and about" and apparently but little worse for their ailment.

(*Second Epidemic.*)—Early in November of the same year, that is, but three months after the first epidemic, the same patient who was first seized with the previously described illness, consulted Mr. Barnes, and was thought to be suffering from a severe feverish cold. On the eighth day of illness a rash appeared, the eruption being identically the same as on the previous occasion, the entire illness simulating measles in every particular.

Within a short time an epidemic of much severer type than the first was raging over this district.

One hundred and seventy-one cases came under the notice of Mr. Barnes, and of these 158 had suffered from the August epidemic, and ten had had measles before. With regard to symptoms, the prodromal and eruptive coryza was not marked. But the bronchial catarrh was in many cases extremely severe. There were forty-five cases of broncho-pneumonia; six deaths and many narrow escapes. Two patients suffered from the hæmorrhagic form. Both succumbed to the attack.

The symptomatic differences between these two epidemics may be shortly summed up as follows: The prodromal stage of the first was accompanied with pyrexia, headache, sickness, distinct coryza, and little or no cough. The rash came out freely and fully, dying away without staining the skin within four days. The intensity of the exanthem diminished as it spread. In the second epidemic, the prodromal stage was not so decidedly marked and there was less coryza. In its place bronchial catarrh was largely present, in many cases complicated by pneumonia. The rash was frequently dark in colour, coming out badly and lasting several days, leaving the skin much stained.

There can scarcely be a doubt that the contagium of the first epidemic was that of measles of mild type; with regard to the second, opinion will differ. Was it a contagium specifically distinct from measles, or was it a contagium of measles of unusually severe type which fell upon a "soil" receptive by reason of the peculiar intensity of the poison—a "soil" in which the mild intensity of the previous exanthem had failed to produce absolute immunity against a second attack?

The following case presents a measle-like exanthem in its mildest form.

A. B., a child, aged 14, went to bed feeling perfectly well on the evening of February 11, 1893. On waking in the morning the face and upper part of the chest were covered with a measly rash. The eyes were suffused and watery, and the gland on mastoid swollen but not painful. No catarrh or other constitutional disturbance; temperature 99°. The following day rash had nearly covered the body; on the face the papules had coalesced into somewhat raised blotches; the eyes were more suffused, but there was no rise of temperature. On the third day the rash on face began to fade, becoming confluent on extremities. On the fourth, there was a general fading of rash. This eruption was neither preceded nor accompanied by any catarrhal symptoms.

An opportunity for seeing some patients suffering from an extremely mild type of measly exanthem occurred to me in the spring of 1892. Three children were sent home from school in consequence of several of the pupils having a mild form of measles. A few days after being at home, each child developed a rash, which was papular, discrete, and sparsely scattered over the entire body. Two of the children had absolutely no constitutional disturbance. The third had a slightly raised temperature (highest 99·4°), and in this patient the glands on the mastoid process were raised, swollen, and painful. Within a fortnight an infant contracted the exanthem though without being ill. The mother and several of the servants also developed rashes, but in no case was there any constitutional trouble. Now in this group immunity against an attack of ordinary measles had not been gained by a previous infection, none of the four children having ever had any kind of measles. This exanthem was evidently peculiarly infectious.

Prod. Sym.

Attention has already been drawn to the striking absence of uniformity among those authors who describe the clinical features of rötheln. Such is not the case with measles; all authorities agree as to the fundamental symptoms which mark measles as a specific exanthem. We all recognise this portrait as true:—A rash, more or less characteristic, preceded by a prodromal stage of three, four, or more days, during which catarrhal symptoms are present, and accompanied by pyrexia. Examine authority after authority, and we shall find these symptoms in the main forming the basis of the clinical description of measles.

With regard to rötheln, the case is widely different. There is no general agreement as to what special symptoms mark the disease as being specific. There is, I believe, an explanation of this want of harmony which I shall fully discuss; for the moment I wish to call attention to some of the reasons which are given in our principal text-books for looking upon the affection as being specifically distinct from measles.

Aitken describes the differences between measles, rubeola and scarlet fever in parallel columns, stating that rubeola differs from measles in the shape, character, and duration of the rash. Ringer, writing in Reynolds' "System of Medicine," does not allude to rubeola, although he describes those rashes which may be mistaken for measles. Bristowe states that the rash of rubeola is different from that of measles, and is often coincident with the invasion period. It is not so contagious. He sums up the distinctive differences as follows :—Slight initial fever ; almost complete absence of catarrh ; general arrangement of rash ; mildness of attack ; mutual unprotectiveness.

Robert Liveing says : "Rubeola differs from measles in duration of initial fever." He adds : "Rubeola is often accompanied by catarrh, and is not infrequently complicated by albuminuria." Squire, writing in Quain's "Dictionary of Medicine," gives as the characteristics of rubeola : the sudden onset without coryza or sneezing ; the distribution and arrangement of the rash ; the range of temperature and the implication of the small glands of the neck, and especially the enlargement of the gland on the mastoid process. Niemeyer considers the disease as characterised by a scarlatinaform rash, accompanied with the ordinary catarrh of measles. Fagge gives his opinion with great caution, and evidently does not consider there is any very decided difference between rubeola and measles. He considers rubeola to be ill-developed or anomalous measles. The well-known argument that rubeola and measles do not mutually protect the one from the other, does not appear to him of much weight, and, he adds, can be "easily overrated." Thomas, writing in Ziemssen's "Medicine," states that the catarrh, though present in rubeola, is not so severe as in measles.

Albuminuria is very rare ; there is no prodromal stage. The eruption has the same distribution as in measles, but the eruptive period is very rapid, the entire body being covered within a very short time.

The etiology of rubeola was discussed at the International Congress of Medicine held in London in 1888. The discussion followed the reading of five papers on the subject by Drs. Cheadle and Squire, of London ; Dr. Kassowitz, of Vienna ; Dr. Smith, of New York ; Dr. Shuttleworth, of Lancaster, respectively. Ten physicians joined in the discussion, and they all more or less differed in their opinion on the subject : with one exception they all gave different reasons for regarding rubeola as being specifically distinct from measles. As I wish to emphasise this unusual absence of uniformity in the description of a purely clinical state, I have abridged these individual opinions, and merely give the principal reasons for looking upon the two diseases as being distinct.

(1) Sudden onset of rubeola without the catarrhal symptoms of measles.

(2) The distinction difficult to describe, but where the two diseases are seen in company, the distinction easy and pronounced.

(3) Variability of incubation stage ; high temperature at the commencement of rubeola. The course followed by the rash.

(4) Rubeola always found following epidemics of measles.

(5) The colour of the rash alone pathognomonic.

(6) Had no doubt of the difference, but could not say diagnosis was easy.

(7) Considered there were numerous differences, rubeola being extremely contagious and without fever.

(8) States that physicians of large experience do not hesitate to consider rubeola as distinct from measles.

(9) Rubeola can be diagnosed on the second day of rash

from colour of eruption and from the fact that on this day the fever is at its height.

Dr. Fagge's views have been already given. Wishing to refer to his article again, I was surprised to find that in the new edition of his work on "Medicine," the original article had been expunged, a new chapter having been written by the editor, in which he takes an entirely different view to that held by Fagge. He considers the disease as one of specific entity, founding his opinion on the following grounds: that the essential character of rubeola is to be found in the fact that it resembles scarlet fever in its short prodromal stage and by being attended by marked sore throat: that the infection is less active than that of measles, and less persistent than that of scarlet fever. He further adds that sore throat is invariably present and catarrh much less frequent, "so that it is very distinct from measles."

Among the later writers on the subject may be mentioned Dr. Hopwood, of the Islington Fever Hospital, whose vast and special experience must entitle his opinion to the greatest respect. Knowing that to his care was entrusted the article on rubeola in Fowler's "Dictionary of Medicine," I looked forward to its publication with much interest. Dr. Hopwood is, without doubt, a firm believer in the dual nature of the contagia of measles and rubeola, but when his paper is carefully read one cannot help feeling that he has found it difficult to substantiate his convictions. He differentiates the affection from measles by the shortness of the prodromal stage; by the enlargement of the glands of the neck; by the lighter colour of the rash and the smallness of the individual papules; and he also calls attention to the general mildness of the complaint, the unimpaired appetite, and the slight rise of temperature. He states: "In some cases the diagnosis from measles is very difficult."

Among those physicians who strongly uphold the distinct specific nature of rubeola, may be mentioned that astute and careful observer of clinical symptoms, Trousseau.

He looked upon the disease as being absolutely separated from measles by the absence of catarrhal symptoms during the prodromal stage.

"Mais ce qui distingue tout de suite la roséole de la rougeole, c'est l'absence dans le premier cas du catarrhe oculaire, nasal, et bronchique, phénomène obligé de la période prodromique de la fièvre Morbilleuse. Jamais, en effet vous ne verrez, dans la roséole le larmoiement, le coryza, la toux de la rougeole."[1]

Now, if the absence of various forms of catarrh during the prodromal or invasion period of rubeola could invariably be proved to exist, undoubtedly it would be a very important point, and would serve as a fundamental distinction between the two diseases. But in the present day we find observers differ as to whether catarrhal symptoms are absent or not. We find the prodromal catarrh of rubeola spoken of as being *extremely variable.* It is reported as being present during some epidemics while it is absent in others. We find the same variability as regards catarrhal symptoms among sporadic cases. I have made notes for many years on this point, and I find the following memorandum in my case-book *apropos* of two brothers under my care for measles, in the year 1880. "The elder is suffering from ordinary measles, severe catarrhal symptoms ushering in the eruptive period, while the younger commenced his attack with a rash as the first symptom, and has no catarrh. This latter case, if seen alone, would certainly be called 'German measles,' but there can be little doubt the contagium is the same in each case."

Another case bearing upon this point occurred to me in

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[1] "Clinique Medicale," par A. Trousseau, deuxième edition.

1891. In the March of that year, I was asked to see a lady who had been suffering for some days with a severe feverish cold. I saw the patient late at night. She was complaining of headache and had all the symptoms of very severe catarrh ; there was no rash, but from the high temperature, plus catarrhal phenomena, I diagnosed measles, and the following morning—the fourth day of illness—a few scattered papules on the face confirmed the opinion I had given. The attack was a severe one, but regular and without complication, the cough being a very troublesome symptom. The glands below the jaw and those of the neck were swollen and painful. The illness from first to last was typical of ordinary measles.

Ten days later her two sons, school-boys, were poorly, with slightly raised temperature and general malaise, but with absolutely no trace of any form of catarrhal irritation. The rash appeared within a few hours of the initial malaise, and the eruptive period, marked by intense rash, was uncomplicated with catarrh excepting a slight irritable cough. Now, if these two lads had been seen alone, without doubt their illness would have been called rötheln, whereas that of the mother, from whom the infection arose, was purely typical as regards complete symptomatology of ordinary measles.

Again, on April 18, 1889, I saw a child, aged 14, suffering from an intense catarrh of three days' duration. When I saw her she had a raised temperature and a few papules behind the ears. She had been sent home from school as feverish and ill. She passed through an attack of ordinary measles. Fourteen days after her return home a younger brother and sister fell ill with measles ; one had a slight cough concurrent with the eruptive stage, the other no sign of any form of catarrh during the entire illness.

At the country house of some friends of mine the butler sickened with measles, preceded by the ordinary catarrhal stage of three or four days' duration. The disease spread through the house and several children were affected, but their attack was uncomplicated by catarrh and was thought to be " German measles."

These cases may be taken as sufficient proof that occasionally we may find the specific contagium of measles producing an illness which is devoid of the ordinary catarrhal stage of that well-known disease, and I would now ask if the converse is also true. May the contagium arising from an exanthem which, *per se*, would be entitled to the designation rötheln, give rise to an attack with the symptoms of normal measles, that is, measles plus prodromal catarrh? From my own experience I should answer in the affirmative, though I cannot produce as much clinical evidence in support of my opinion, and the only case in which a severe prodromal catarrh preceded measles and in which, so far as I could learn, the infection had been conveyed from so-called German measles, was a lad, aged 10 years, seen by me in July, 1888.

Here the child, twelve days before his illness, had been to a children's tea-party; the following day two of the guests sickened with a rash without catarrh, and passed through an attack of rötheln. But here, although much trouble was taken to ascertain the source of infection and although it seemed probable the source was that alluded to, there must remain a doubt as to origin of the contagium. I have had frequent experience of cases in which, as regards the primary case, the eruptive period has been without any catarrhal symptoms, but where patients infected from this source have developed an attack in which catarrhal symptoms have been of great intensity, but concurrent with the eruptive stage. The first case referred to at the commencement of this paper is a good and typical instance.

Since writing these lines, I have had the opportunity of seeing a child suffering from measles, in whom there were four days of the most intense prodromal catarrh, the infection having been derived from a brother who, twelve days before, had been suddenly seized with illness characterised by a measly rash appearing as the first symptom of the affection, the course of the exanthem being absolutely devoid of catarrh.

I saw this patient in consultation with Dr. Reichardt, of Ewell, on the evening of the fourth day of the catarrhal phenomena. The eyes were suffused, streaming and intolerant of light; there was constant cough, sneezing and ordinary symptoms of coryza. Temperature 104°, with some delirium. A few sparsely scattered papules determined the nature of the illness. In this case there was not the shadow of a doubt but that the contagium, setting up a pure typical measles, had been derived from an individual in whom all the symptoms were as typical of so-called rötheln.

In practice, we meet with exanthems of measles type falling within the following groups :—

(1) The eruptive period preceded by three, four or more days of catarrhal symptoms. Among this group, which comprises typical measles, we meet with much variety as regards this initial catarrh, this variation in the intensity of the catarrhal phenomena being often markedly apparent even in a house epidemic where the severity of the primary catarrh may vary within wide limits.

(2) Eruptive period without prodromal catarrh, the catarrhal symptoms being concurrent and gravescent with the eruption.

(3) Eruptive period without catarrh, prodromal or otherwise, the initial symptoms being those of slight fever and malaise.

(4) Eruptive period without prodromata, and uncomplicated with catarrhal symptoms during its entire course, but accompanied by pyrexia and swollen glands.

(5) And lastly, we occasionally witness an eruptive period without prodromal symptoms and, moreover, uncomplicated throughout by constitutional disturbance of any sort or kind.

Probably many observers would place in another group those cases in which the eruption is scarlatinaform; cases in which the differential diagnosis is often one of great difficulty and anxiety.

Clinically, we find these groups merging one into another. Seen as separate, distinct cases, they appear to be sharply defined and specific. The more the group or epidemic partakes of the characteristics of the abnormal type, the more impressed we are likely to be as to the specific or peculiar nature of the affection. It seems likely that potentially the intensity of contagium may largely vary, and we know that the receptivity of the "soil" may also vary much.

When we examine the writings of those who describe "rötheln," we shall find one symptom upon which there is an absolute conflict of opinion, some authors stating that the disease is non-contagious, while others state with equal assurance that it is eminently so. The affection is also described as being but mildly contagious (Pye-Smith, Hopwood). It is difficult to reconcile such opposite views, and I think it is possible that occasionally a form of erythema, with papular arrangement of rash, is mistaken for rötheln. Such an eruption I have met with on several occasions, and I must confess that it has most closely mimicked the rash of rötheln.

The following are cases illustrating this form of papular erythema.

The first case, although it occurred twenty years ago, has left a vivid impression on my mind. I was asked by a friend to see a child who had that morning developed a rash and was seen by me to be covered from head to foot with a bright red papular eruption, without the slightest constitutional disturbance. The children were on the point of going to an entertainment, and my opinion was asked with regard to the contagiousness of the affection. I considered that it would be prudent to look upon the affection as contagious. A little later in the day my friend's own medical adviser saw the patient, and pronounced the disease to be "German measles," stating that there was not the slightest fear from infection, and that the children might mix with others without any hesitation. This was done, and no ill results followed ; the rash faded within three days, and at no time did the patient suffer from any constitutional disturbance. With the experience of later years I believe the case to have been one of simple erythema.

Some years later a young woman was under my care, suffering from functional paralysis, with extreme constipation, which could only be overcome by the strongest purgatives. On awaking one morning her whole body was found to be covered with a bright red papular rash; the eruption was like that of measles but without crescentic arrangement, the papules being individually larger and perhaps slightly more raised. With this distinct rash there were no symptoms of constitutional disturbance; the eruption lasted three days and was at its height on the first morning. No other case appeared among other inmates of the household, and I have no doubt the attack was erythematoid.

A third case, which I believe may fairly be classed in the same category, was a child, aged 15, who had been under my personal care on previous occasions for a slight but normal and definite attack of measles, and subsequently for another illness, not to be distinguished clinically from severe measles. This patient was found one morning to be covered from head to foot with a distinct bright papular rash, but without the slightest constitutional disturbance of any kind. The rash, as in the last case, was at its height within the first twenty-four hours, and had faded by the fourth day. The patient was not isolated, and was frequently seen by two other children, neither of whom had had any form of measles ; they both escaped infection.

But lately I was asked to see a child suffering from slight pyrexia, and an indefinite papular rash. Here the case was evidently of rheumatic nature ; there were patches of erythema nodosum on the legs, and the papules were of the same character. I should not refer to this case, but for a remark made to me by the child's mother who, when I stated that I considered the attack to be essentially rheumatic, said : " S. has had several of these attacks before and they have always been called German measles."

I have now briefly referred to the main clinical symptoms which accompany the course of so-called " German measles." I have quoted numerous authorities and I have drawn attention to the extraordinary disagreement as to what constitutes the specific difference between this affection and measles.

This absence of general agreement might be still further illustrated by reference to various papers which I have not alluded to, especially one by Messrs. Willcocks and Carpenter, published in the *Practitioner* for 1887 ; a communication to the *Lancet* of 1877, by the late Dr. Julius Pollock ; a report on a school epidemic by Dr. Douglas in *British Medical Journal*, 1877, and a paper by Dr. Townsend, of Boston, U.S., in the *Archives of Pediatrics*, 1890. Dr. Haig-Brown, of Charterhouse, and Dr. Dukes, of Rugby, have also paid much attention to the subject.

When these various reports and opinions are compared one with another we shall find that scarcely any two will square as regards the specific symptoms or assemblage of symptoms which invariably differentiate the one disease from the other.

Medical opinions are proverbially said to differ, but it is certainly strange that there should be such an absolute want of harmony in the description of a well-marked clinical sequence of objective symptoms.

In viewing this apparent discord, it appears to the author that harmony may be restored by applying to the elucidation of a difficult and complex problem that solution which has borne such abundant fruit, and which has so materially advanced our ideas and views in other branches of biology. He believes that it is legitimate to attempt to explain the phenomena of the apparent absence of specific characteristics in the natural history of rubeola, by bearing in mind that in proportion as we study the clinical effects of the same organic virus, under different conditions and in distant, may be, isolated areas, the more difficult it becomes to define the precise specific characters which attend the stages of development within the tissues of its " host."

If such solution be accepted even but in merest outline, it will supply a working hypothesis which will help to explain those extreme variations of symptomatology which every practical physician must admit do take place, not only in the natural history of measles, but far more frequently in its twin sister rubeola, whether or no he regard the contagium of the one as being specifically distinct from the contagium of the other.

The clinical definition of any infectious or contagious disease does not include, as part of such definition, a factor peculiar to the attack, a factor, moreover, which is of special importance to the individual sufferer. I allude, here, to a characteristic which is invariably present—the specific intensity or virulence, the type or degree of force with which the disease affects the individual.

The specific intensity of any infectious or contagious disease is more prominently brought before us when such a disease is present in epidemic form, all epidemics being invariably marked by graduated degrees of intensity and variation in their respective symptoms. It would be feasible, with sufficient clinical data, to arrange epidemic outbreaks in curve form. If such a curve be constructed, the zenith will be found marking those in which individuals of an aboriginal population become affected with a specific contagium, and where, independently of proper care and treatment, the disease is expressed in much severer type. Lower down the chart the curve will denote epidemics in which the intensity of contagium has been profoundly modified by the surroundings of the affected area, the environments being peculiarly favourable to the growth and luxuriance of the specific contagium. Still lower in the scale come those epidemics affecting individuals of a community who have been long unexposed to the specific contagium, and where we may, with reason, assume that the "soil" is approaching that peculiar receptivity seen in aboriginals. The zero of our curve will note those indefinite outbreaks of exceedingly mild type, where case after case occurs with scarcely a well-marked symptom, and where difficulty would be felt in expressing a confident opinion of the nature of the illness, if it were not that the individual sufferers were in immediate contact with those in whom the attack presents features truly characteristic.

Such a curve practically would be difficult to form. Individual experience is finite, and when we turn to the valuable reports of the medical officers of health, although the intensity of the respective attack is always a matter referred to, this specific virulence in many reports is only to be inferred from the mortality tables. Thus we lose touch with those epidemics in which the virulence is of lower intensity.

It is with measles that we specially see this marked variation of type. There is a note on this point in the introduction of the Report of the Registrar-general for 1891, attention being there drawn to the irregular distribution throughout the country of fatal measles. This irregularity in the distribution of the mortality is to be noted year after year and "in a great degree is determined by the varying periods of time that have elapsed since the occurrence of former outbreaks in the respective districts, for when a county or other area has been visited by a severe epidemic there is for several succeeding years scarcely sufficient material in the shape of unprotected children for another considerable outbreak."

As the type becomes less virulent, the symptoms are *pari passu* less severe. Individually they become mitigated, or in some cases entirely suppressed, and an outbreak of large dimensions may, by reason of slight benign symptoms, be absolutely differentiated from the severe forms of the same affection.

Some may think that my allusion to the milder forms of epidemic disease is fanciful. I would refer them to the reports of the Caterham outbreak of enteric fever in 1878, and to the late Dr. Spear's[1] most valuable and instructive account of typhus fever occurring at Nazareth House, Hammersmith. To those who read this latter report for the first time, it will probably be new knowledge that we may have in our very midst a disease of such extreme infectiousness as typhus, present week after week, month after month, and yet withal presenting such a low type of intensity—with specific characteristics so profoundly modified as to be constantly overlooked and mistaken. Yet we know full well that under favourable circumstances, such as squalor, dirt and poverty, this specific contagium will, without doubt, assume its wonted garb of virulent intensity.

The fact that the symptoms and intensity of different fevers are liable to vary did not escape the attention of Sir Thomas Watson, who, writing in the early part of the present century, describes epidemics as being endowed with certain variations as regards both intensity and symptoms.

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[1] Report of Local Government Board, 1886: Dr. Spear, "Presence of Typhus in London."

He writes[1]: "There are great varieties also in the general character of the symptoms that occur in different epidemics of the same disorder. At one time, or in one place, inflammatory symptoms run high ; in another place, or at another time, there is an early tendency to debility or sinking. One epidemic is more malign than another. And the practice varies accordingly : so that these are facts of the greatest importance."

The prevailing character of the malady is attributed to what is called the "Epidemic constitution of the season," and when we have made out by observation what this epidemic constitution is, "we have obtained a clue to the proper management of the disorder."

Sir Thomas Watson describes these peculiarities of different epidemics as being probably entirely due to predisposing causes, of which he looks upon the weather as being most potent, and as certainly not due to any variation of the exciting cause, which assertion, with our present knowledge, is tantamount to a disbelief in the variation of respective contagia.

It is, I may say, knowledge common to us all, that epidemics small or great are marked by varying degrees of intensity. In every epidemic, with but very few exceptions, all the individuals falling under the influence of the specific contagium are affected by the type, be it mild or severe, of the prevailing character of this specific contagium. In other words, it may be justly said that a specific contagium "breeds true" with regard to type or intensity.

As a matter of every-day experience and practice we are constantly assuming the truth of such a law.

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[1] Watson : "Practice of Medicine," second edition, p. 660, vol. i.

In epidemic disease, be it variola, scarlet fever, measles, enteric fever, diphtheria, influenza, we are in the habit of weighing the danger to individual sufferers by our knowledge of the prevailing type of the affection. It may appear a very simple matter to affirm that a specific contagium, although liable to vary, generally affects individuals of a community with corresponding degrees of force or virulence, yet if such be the case it establishes one of the most important facts in connection with our knowledge of contagious or infectious disease. Moreover, it places the behaviour of these respective specific contagia much in the same category as seen in those cultivation experiments carried on in our laboratories, experiments which have done so much in advancing knowledge as to the biological relations and life-history or micro-organisms.

The teaching and practice of former years was certainly opposed to any such doctrine as "the maintenance of type." It was taught as cardinal that type could not be considered as constant, and it was generally asserted that there was no guarantee but that the most benign case of any infectious disease might not in another give rise to an attack, formidable as it was virulent. In other words, the teaching of the day was that a specific contagium did not "breed true" as regards its peculiar type or intensity.

Doubtless such teaching, from many points of view, may be considered correct even when viewed with current knowledge. Epidemics are clothed, so to speak, with the same intensity, and the infectious disease is passed from individual to individual with fairly equal force. Exceptions to this law do occur, but when carefully examined they do not seem to afford sufficient proof that the variation in type is entirely due to variation in the specific contagium, but rather to variation in the *receptivity* of the individual who becomes infected, the variation in intensity of any specific contagium being principally due to conditions of "soil."

This law is brought before us in a very striking manner when the behaviour of the specific contagium of variola is watched falling upon "soil" endowed with varying degrees of resistance by vaccination. We are in possession of facts which but very few will question, that the power of influencing the degree of intensity or virulence of small-pox *is almost absolutely under our control.* We also know that the virulence with which the contagium of measles, typhus, or diphtheria, affects an individual, can be largely modified by the environment of the individual affected. By such environment we can certainly increase, and, I would say, frequently decrease the virulence of the contagium. Place the contagium of typhus in conditions known as being favourable to its growth, and we shall soon have abundant opportunity for watching the increased virulence. The same may be said for diphtheria.

In the Medical Officers' Report to the Local Government Board for 1889, there is an interesting article from the pen of the late Mr. John Spear on an epidemic of measles occurring in the Staffordshire Potteries in 1888-9.

The specific type of these cases was most severe, but if we read the report there cannot be the slightest doubt that the intensified type was not due to any peculiar property of the contagium, but was absolutely caused by the unsanitary condition of the neighbourhood. At Hanley, a part of the district attacked by the disease, the number of cases exceeded 3,000, the mortality being equal to 9 per cent., which, as Mr. Spear remarks, "was enormous for measles." In discussing the prevailing type of the disease, attention is drawn to almost every form of unsanitary environment, and the cases here quoted with far more length than I can now afford, give a marked instance of *type modified by external conditions.* A similar modification of the essential type of a specific contagium may occasionally be witnessed in a house epidemic.

The following cases which I shall now quote give an excellent and striking example of the contagium of measles becoming intensified by the presence of sewer gas in the house where the illness originated.

On April 13, 1890, I saw a child who was suffering from an ordinary uncomplicated attack of mild measles. The child's bedroom was airy and at the top of the house. The attack passed off without any anxiety or complication. Within the next fourteen days four other children were ill, the illness commencing in each case with pyrexia. The eruptive period in each of these cases was much prolonged, and in one of the children the rash was hæmorrhagic, being of a dark prune colour. The attack speedily proved fatal. The three remaining children were gravely ill, all symptoms being irregular and severe, the temperature fluctuating within wide limits, some days reaching its highest point in early morning, on others at mid-day. Lung complications were present in each patient, and assumed the form of a patchy pneumonia. The rash appeared—if I may be allowed the expression—in "fits and starts," some days as if fully out, and then receding only to re-appear within a few hours. The cases from beginning to end were totally unlike anything I had before seen.

My suspicions as to the sanitary state of the house had been raised early in the course of the illness; the air of the house was peculiarly stuffy and at some times absolutely offensive. The rooms occupied by the children were on the second floor, filled with boxes and furniture, and were badly ventilated. There seemed to be no end to complications—one followed another.

On May 10, being eighteen days from the commencement of the secondary outbreak, the condition of two of the patients was very anxious, principally from irregularity of temperature and the state of chest. On this day arrangements were made to remove the patients to a country house ten miles from town. During this journey the temperature fell and did not again rise. Within a couple of days the lung trouble had entirely disappeared, and within the week all three cases were considered convalescent.

A fifth child had come in contact with the first case but had gone into the country. He developed measles at the same time as the other children, but his attack was mild and without any complication.

The drainage of the house was subsequently examined and a large perforation of the main drain passing under the house was detected. Looking upon this outbreak from all points of view, I have no doubt but that the virulence or intensity of the contagium was enormously increased by the presence of impure air, and that this intensified type modified the clinical course and symptoms of the illness.

Some years past I saw a patient, in consultation with the late Mr. Hubert Weiss. The case was supposed to be commencing " typhoid," but, from the severe catarrh and a few scattered papules behind the ears, I ventured to make a diagnosis of measles, which disease the attack eventually proved to be. The illness was most severe and irregular. The eruptive period was prolonged, accompanied with much pyrexia and delirium, though without other complication. During convalescence this patient was again seized with measles, and although the second attack was not nearly so severe as the first, it was definite and unmistakable. I only saw the patient once, the details of the illness being subsequently given to me, and at the time I had no suspicion of the presence of sewer gas within the house. Some months later I was again asked to see another patient in the same house, the symptoms being solely loss of appetite and a high evening temperature. I could detect no organic cause for the pyrexia, and from other reasons looked upon sewer gas as the possible and probable cause for the state of the patient. The patient was removed to the country and had no return of pyrexia. The drainage of the house was found to be in the most inefficient, filthy condition, the house practically standing over an open cess-pit. I have no doubt the irregular, prolonged, severe course of the measles was directly the result of this foul state of air, and the case affords another instance of the modification of the contagium of measles by external influences.

A pinch of seed sown broadcast over widely varying soils will produce widely varying results. So the specific contagium of any infectious disease will produce results profoundly modified by the " soil " upon which it may chance to fall.

The respective receptivity of individuals varies much, and we know that receptivity is mainly influenced by the fact that the individual exposed to the action of a specific contagium has or has not suffered from a previous infection.

It would be a matter of extreme interest and vast importance if we could prove clinically that the respective receptivity of any individual varies in direct ratio, not only to the quantity, but to the quality (intensity) of that specific contagium which may have given rise to a definite attack of illness. In other words, will the specific contagium derived from a case of low intensity confer immunity in the same degree as that arising from more pronounced type? Does a mild attack of measles, with all its specific symptoms but faintly marked, confer the same security as undoubtedly follows a severe seizure?

Although the specific intensity of contagia apparently passes from individual to individual unaltered, if so be that the receptivity of the respective individuals does not vary to any wide amount, still, if the soil upon which a contagium falls is peculiarly adapted for its growth, we may witness the apparent anomaly of a contagium of mild intensity assuming the properties of one of great virulence. And this conflicting clinical experience is sufficient to account for the opinion of the older writers, *i.e.*, that contagia do not "breed true" with regard to intensity.

It is because the specific intensity of any contagium may be profoundly modified by the soil on which it may chance to fall, that in practice we occasionally meet with instances where a mild contagium has given rise to illness marked by the contrary clinical features. Were it not so, a variola of great intensity, as found in hæmorrhagic small-pox, would invariably produce in another individual an attack of similar intensity. We know that this is not the case, and we know that by modifying the nature of the soil upon which the virulent contagium may fall, we can enormously influence the course and nature of the attack which has, without doubt, been caused by a contagium of very high potentiality. And again, we may, as I have already stated, occasionally witness a contagium of mild intensity assuming great virulence through modification of the soil by environment.

When an aboriginal population is struck down and decimated by measles assuming a type of great intensity or virulence, we have no ground for assuming that the primary contagium lighting up the epidemic was of more than ordinary intensity.

In discussing the possible relation existing between amounts of specific contagium necessary to cause a definite illness, endowed with those clinical symptoms which we are accustomed to look upon as symptomatic of the illness, we are treading upon dangerous ground, and we must confess to having little true knowledge on the matter.

From the clinical evidence I have been able to examine on the subject, support would be given to the argument that quantity may, under some conditions, distinctly influence the clinical features of an attack. And on this point the epidemics of enteric fever due to contamination of the water supply at Caterham in 1878, would appear to afford a striking instance. In this epidemic the degree of dilution of the contagium must have been enormous, and the clinical characteristics of enteric disease were in a large majority of affected persons but slightly expressed. In house epidemics of typhoid fever we frequently have the opportunity of seeing the disease with widely varying intensity, such variation being possibly due to the initial amount of contagium giving rise to the attack. It is also important to bear in mind that attenuation of virus may be produced by the effect of the menstruum which forms for the time its habitat.

The variations or degrees of intensity may be well seen in comparing epidemics, and, indeed, sporadic cases of diphtheria. In this disease we may see every condition of throat trouble, from merely congestion to its more malignant congeners ; and we may find examples varying within these wide limits in a series of cases in which there cannot be the slightest doubt but that the contagium has been specific and derived from the same source.

A study of the clinical course of most, if not all, contagious diseases brings before us another property of such diseases : namely, that with a diminished intensity there occurs a suppression of one or more symptoms of the normal type.

Again, we may frequently have the opportunity of seeing that distinct epidemics may be especially marked by the peculiar prominence of any one symptom.

During the winter (November to February), 1891, there appeared much diphtheria in the neighbourhood of the West London Hospital, and, consequently, many cases were admitted into that hospital. With scarcely an exception, all these cases were marked by extreme asthenic conditions ; symptoms of low nerve-power of heart and stomach occurring early in the disease. Among these cases but a very insignificant number suffered from laryngeal complication, whereas on a former occasion this formidable complication had been general. With enteric fever, is it not true that we may have case after case where some one important symptom appears to be either increased, diminished or absent? A series of cases will occur with such constipation that we may always feel inclined to look upon this state of bowel as symptomatic of the attack. Experience, far larger than I possess, will, I believe, support me in the assertion that all contagious diseases are liable to express themselves with varying degrees of force with regard to their individual symptoms. And I believe that not only do such diseases occur with varying degrees of force as regards special peculiar symptoms, but that the contagium at different times, that is, from different sources, affects or may affect different tissue tracts. Except there be some such law I fail to account for the perplexing and conflicting array of symptoms seen during the past three years in patients suffering from epidemic influenza.

One of the main reasons for regarding the contagium of measles as being specifically distinct from that of rötheln is the fact that the one disease, or, as I should prefer to say, the one clinical condition, does not appear to protect from the other.

That these two conditions are mutually unprotective is of great importance, and will require careful consideration. There are some observers who state with almost absolute confidence that one attack of measles will, with but very few exceptions, convey absolute immunity against a second.

Among those who hold strongly this view may be ranked Dr. Cheadle, whose paper, read before the International Congress of London, I have already referred to.

It will be necessary to look rather closely at his line of argument.

Dr. Cheadle commences his paper with the following remarks : " One of the main points laid down as distinctive of the group of contagious exanthemata, from the time of Cullen downwards is, that each disease occurs in the same individual but once in a lifetime—that is, that one attack of any one of these eruptive fevers confers on the individual who suffers it, immunity from a second, and the rule has been found to hold good, not indeed, as absolutely invariable, but with exceptions so few and rare as not seriously to invalidate the general law."[1]

Again, he writes : " I might quote a large number of authorities to show that, although a few exceptions have been recorded, the law holds—that one attack of measles affords almost certain protection against a second." After making these remarks and others supporting them, Dr. Cheadle proceeds to describe an epidemic coming directly under his own observation in which a disease—an eruptive fever—closely resembling severe measles, attacked numerous families and affected many individuals who had been known to have suffered previously from measles.

The knowledge that these patients had suffered previously from measles of undoubted type, led Dr. Cheadle to look upon the disease as differing from true measles. He considered that the law determining immunity was of such an invariable nature that the fact of individuals suffering a second attack of an eruptive fever, although closely resembling measles, was sufficient grounds for him to regard the disease he was then describing as being of a different species. " For," says he, " the special features observed in the epidemic of 1879, added to the evidence afforded by the absence of any protection conferred by previous attacks of common measles, confirm the view that the disease in this outbreak was specifically distinct, and if so the question arises whether it is a new and previously unrecognised exanthem or a severe form of so-called German measles."

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[1] "On the Existence of two distinct forms of Eruptive Fever, usually included under the head of Measles and the relation to them of so-called Rubeola or Rötheln," *Trans. Int. Med. Cong.*, 1881, Dr. W. B. Cheadle.

Meeting the objection that rötheln is usually described as being a very mild complaint, Dr. Cheadle sums up his arguments in the following manner:

"It seems impossible to avoid the conclusion that the disease in the second epidemic I have described was that variety known as rubeola, epidemic roseola or rötheln, which exists, not only in the slight and unimportant form generally recognised, but as an eruptive fever of considerable severity which may assume a dangerous and even malignant type."

Now, in reading through the clinical reports of the cases referred to by Dr. Cheadle, there is practically no single factor which separates these cases from those of ordinary measles of severe type. Dr. Cheadle acknowledges as much in his paper, and his opinion that the patients were suffering from a severe form of eruptive fever distinct from measles was formed solely from the fact that many of them had previously suffered from ordinary measles.

The value of the differentiation between measles and rötheln in the above paper would appear absolutely to rest upon the question whether or no one attack of measles so invariably confers immunity against another, that a patient, passing through measles and subsequently suffering from an illness clinically the same as measles, must be considered as having had rötheln as one of the illnesses: for I should find it hard to say of two such illnesses, which was rötheln and which was measles!

I have seen many instances of patients being attacked by an illness clinically not to be distinguished from measles whom I had previously seen suffering from measles of an undoubted type. Moreover, I believe a second attack of measles to be far from uncommon ; I have seen a marked instance in my own household.

Some years ago I attended a family of children for measles of fairly severe type. About a year after the illness, I incidentally heard that the same children were suffering from another attack of measles. I at once wrote to the medical man who was in charge—Dr. Propert—and he very kindly and courteously supplied me with full details of the illness. He stated that these children were suffering from an eruptive fever of mild nature, and that he had no doubt the illness was measles. He further stated that he had had "heaps" of similar cases, and in every case the patients had previously suffered from typical measles.

In the *Lancet* for February 21, 1891, is a letter from an aggrieved practitioner who complains of the interference of a medical officer of health, who had contradicted a diagnosis of measles, solely on the grounds that as the child had previously suffered from that disease, a second attack was impossible, and therefore the diagnosis must be wrong. The *Lancet*, in a footnote, very properly observed: "The occurrence of a second and even a third or fourth attack of measles, is well authenticated"—an opinion my own experience would certainly fully corroborate.

The many and decided variations seen in the clinical course of measles suggest that possibly the law of immunity may be in very close relationship to that of intensity. And we may again with truth ask ourselves the important question : Will a contagium derived from measles of low intensity confer the same degree of immunity as a contagium derived from a more decided and virulent source?

If such a relationship between the law of intensity and the law of immunity does exist, it will help to explain many of those anomalous conditions which hitherto have been considered as due to ill-defined, bastard, badly-developed measles—terms as vague as they are unscientific.

It will not be objected that as a class the exanthemata bear classification and definition as well, if not better, than other diseases. But little difficulty will be found in giving a faithful clinical picture of the leading characteristics attending the course of any one of them. With little latitude, the definition will be found to embrace all varieties. But with regard to rötheln this is not the case. At some length I have drawn attention to the marked differences found in the various descriptions of this disease. I have referred to the opinions of some fifteen authorities; they all differ more or less; with some the difference is extreme. Moreover, it will be found if their individual opinions be carefully examined, that they are almost invariably due to a personal conviction founded on a personal experience; that is, the observer has noted a case or cases in which a special symptom or group of symptoms has occurred; and thus the cases or group of cases have been considered as being due to a specific contagium.

Naturally a sporadic case with suppressed, mitigated, unusual or intense symptoms, will not attract our notice in the same degree as a group of cases endowed with similar peculiarities, still more will such disease assuming epidemic proportion rivet our attention.

When we consider that "intensity" is a characteristic always accompanying the illness produced by any one of the contagia giving rise to exanthematous fevers, we must not be surprised to find that this specific degree of virulence will pervade the majority of those affected by that specific contagium.

Moreover, degrees of such intensity are found to be accompanied, not only by variation in the symptoms denoting the specific nature of the affection, but also by variation in the intensity of the individual symptoms themselves.

Thus a sporadic case of measles type may be marked by one or more symptoms standing out in bold relief, or we may witness the reverse, that is, a case in which there may be complete or partial suppression of a symptom or symptoms.

If the symptoms accompanying ordinary typical measles be closely examined and contrasted by comparing sporadic case with sporadic case, group with group, epidemic with epidemic, we shall find that there is no single symptom or group of symptoms peculiar alone to either measles or rötheln.[1] The typical clinical condition known as measles may be clearly defined with regard to all its well-known phenomena. The same may be said for that clinical state known as rötheln; but immediately we leave the case typical of either affection, directly we closely examine cases which appear on the border line of either, we find ourselves constructing link by link a chain of clinical evidence leading from true measles to those anomalous conditions which I believe to be entirely due to measles undergoing variation, or profoundly modified by "soil." And looking, as I do, upon rötheln as being but the contagium of measles passing through stages of evolution, I feel inclined to make use of the words of Wallace:[2]—

"Now . . . we have arrived at a different standpoint and look upon a species, not as a distinct entity due to special creation, but as an assemblage of individuals which have become somewhat modified in structure, form and constitution so as to adapt them to slightly different conditions of life . . . ."

Or to quote Professor Huxley:[3]—

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[1] The incubation stage of true measles is as variable as that of rötheln, absolutely different from that of scarlet fever.

[2] Wallace: "Darwinism," p. 167.

[3] Huxley: "Lay Sermons, Essays and Reviews," p. 270.

"But a race once produced is no more a fixed and immutable entity than the stock whence it sprang. Variations arise among its members, and as these variations are transmitted like any others, new races may be developed out of the pre-existing one *ad infinitum*, or, at least, within any limit at present determined. Given sufficient time and sufficiently careful selection, and the multitude of races which may arise from a common stock is as astonishing as are the extreme structural differences which they may present."

In regarding the contagium of measles as liable to undergo change by means of evolutional processes, and thus giving rise to fevers atypical, I believe we shall be more strictly accurate than by ascribing these atypical affections as due to "sports." The word "sport" has been used in medicine rather loosely, and cannot be applied with the same degree of accuracy as when used in horticulture.

A "sport" from measles would imply the possibility of a typical case of the disease producing a specific contagium which in another individual would cause an illness departing widely in certain particulars from the parent stock, and moreover, by far the most important point, endowed with inherent powers for the continuing these peculiarities, and again at any time, the power of reverting to the parent form (ancestral type).

Practically, we do not meet with these extreme variations in cases where we have the means of tracing the origin of infection. Where an extreme case of variation does arise, the contagium has probably been profoundly modified by "soil" or environment, and the peculiarity in the clinical course of the illness, whether by suppression, mitigation or intensification of symptoms, is due, not to a "sport" but rather to modification by "soil" or "environment."

Although there are writers who consider rötheln as being a hybrid between measles and scarlet fever, I do not propose to discuss such a theory. Hybridism among the highest forms of animal life has puzzled the naturalist, and to look upon the affection we are now considering as being of hybrid origin, appears to me but the wildest speculation. If the contagium of measles be a living organism, and if there be any truth in the now generally accepted doctrine of evolution, the fundamental laws which underlie these doctrines are as true for the lower forms of life as for those higher in the scale.

Hence the living contagium of measles will have to conform to such laws uniformly with the higher forms of organised matter.

The possible relationship existing between various specific contagia and evolutional changes consequent on their individual struggle for existence, has been most ably dealt with by Hubert Airy, in a paper to be found in vol. iv. of the *Transactions of the Epidemiological Society.* He remarks:

" If a contagium be a living organism depending for its support on human susceptibility, it must be capable of variation to match the variations of its human home and food."

Now, it would appear from many reasons that the specific contagium of measles has peculiarities which *per se* renders it liable to evolutional changes. Measles occur more frequently and at shorter intervals than any other epidemic disease we are acquainted with. It is rare for any community or locality to escape infection for any lengthened period of time. It is rare for any single family of children to escape absolutely from infection. Insusceptibility is born of susceptibility.

Varying degrees of susceptibility are passed from parent to offspring; if not, we should constantly meet with cases presenting all the marked features of the disease in its most virulent form; we should see the contagium falling upon virgin soil, and then affecting individuals with the same degree of force as seen in the epidemic of measles among the Fiji Islanders in 1875; who, to use the words of Dr. Thorne Thorne[1]: "Had had no opportunity of acquiring any immunity against the natural force of the poison by reason of heredity." Grant that modification in susceptibility does exist in ever so small a degree, we are bound to admit that it must also be progressive.

The child born into the world personally endowed by the parents with a certain degree of immunity against measles, will, under ordinary conditions, pass on such immunity to another generation with greater force, and we may, I think, infer with reason from the laws of biology, that the tendency towards immunity will progress *ad infinitum.* And in support of such conclusions the study of the behaviour of malarial poison will help us much in appreciating the value of a progressively acquired immunity; moreover, an immunity which is not constant, but is determined by the virulence of the specific contagium.

Bouchard has a striking paragraph on this highly important point. He writes[2]:

"Ce n'est donc pas à une attenuation du virus qu'il convient d'attribuer la décroissance des maladies infectieuses, mais à l'augmentation de l'immunité des hommes. Cette augmentation de l'immunité ne peut être expliquée que par l'hérédité de l'immunité. L'homme, qui par une atteinte de la maladie, a acquis l'immunité presque absolue, ne confère sans doute à sa déscendance, qu'une immunité insignificante, mais capable d'aller en croissant proportionellement au nombre des individus qui contractent à leur tour la maladie dans les générations successives.

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[1] "The Progress of Preventive Medicine during the Victorian era," p. 7, R. Thorne Thorne.

[2] "Thérapeutique des Maladies infectieuses antisepsie," p. 104, par Ch. Bouchard.

Songez que pour la coqueluche dix-huit générations en ont souffert avant vous ; parmi ces 500,000 ancêtres qui, dans cet espace de temps, ont concouru à votre naissance 400,000 au moins ont eu la coqueluche. . . . . Vous avez le benéfice de ces immunités accumulées."

In support of such views indisputable evidence could be produced that, independently of increased knowledge regarding sanitation, independently of more rational treatment, specific contagious diseases are not so directly dangerous to life as they were in former times. The virulence or degree of intensity of all eruptive fevers is of a more benign type. My thesis has, for the moment, to do with the specific contagium of measles, and by comparing the description of older writers with those of the present day, there can be but little doubt that the disease is now expressed in a milder form.

Sir Thomas Watson, than whom a better clinical observer could not be quoted, remarked the difference in symptoms in different epidemics, and he calls special attention to the severer forms known under the name *Putrid Measles*, and well described by his namesake, Sir William Watson, and still further back by Sydenham, in 1670 and 1674.

Measles of this virulent type is now happily very rare ; occasionally a case here and there may assume the characters from unhealthy environment of the individual patient, the intensity of the symptoms being increased thereby.

The wider our experience, the more secure our grasp of knowledge, the fewer will become those apparent anomalies which bestrew the path of medicine. The closer the study of specific contagia, the more narrow will become the lines of demarcation between receptivity and its antithesis immunity.

Allow that the intensity of contagia varies within very wide limits, and that the conditions permitting growth and multiplication of the infecting organism are constantly undergoing change; a change, moreover, which in a large proportion of cases, is directly opposed to favouring the continuance of life of that organism, we should expect to find that the contagium presents, under changed conditions, new characters; characters which, when compared with those peculiar to the parent form, are wanting in force, anomalous, mild, and withal, perhaps, more directly infectious.

But under these changed conditions, masking, as it were, the true nature of the organism, there lies that marvellous power of reversion. We know that under favourable conditions the mild contagium may become virulent and directly dangerous to life, reverting once more to the "ancestral type."

As practical physicians we are daily brought into contact with exanthems closely allied to the measles type—I would say, of genus measles. These exanthems will be found to vary enormously as regards their characters and their clinical symptoms. They differ from one another in prodromata; in dermatological features during the eruptive stage, and in virulence or intensity. At the one extreme we may see measles in well-marked pronounced form; at the other, but a slight papular rash, with temperature barely raised, and with catarrh present only as watery eyes.

I would go farther and say that not only do these phases of measles differ in character of symptoms, but they vary in their power of conferring immunity. The severe typical measles fully expressed with all its clinical phenomena, will protect in much higher degree than its sub-variety in which intensity is absent.

If such be the case, are we to form a special group to include those clinical conditions known as "rötheln"? I take it we shall be more scientific, more correct, if we look upon them as due to the specific contagium of measles which has been profoundly modified by those evolutional changes underlying its life-history; profoundly modified by the varying conditions affecting the "soil" of the "host."

I trust there are those who will agree with me that the hypothesis I have ventured to raise is not inconsistent with known biological facts—facts which are daily revealed in our laboratories, and which appear to me more and more to lend weight to the views I hold.